Drive Genius

PROSOFT
engineering, inc.

Drive Genius User Guide

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Welcome

Thank you for purchasing Drive Genius™

Drive Genius is a collection of tools and helpers that help guard the data on your drive.

Drive Genius is designed from the ground up specifically for Mac OS X, focusing on providing the best drive maintenance and management tools. Drive Genius optimizes drive performance, protects data and provides easy-to-use yet powerful features for your storage needs.

Drive Genius can defragment a volume, analyze a volume and repair it if necessary. Its testing capability goes a few steps above other drive utilities with media surface scanning and long term data integrity checking. Drive Genius can also measure the throughput of the drives to see if they are performing up to par.

The powerful repartitioning feature enables you to resize your drive without reformatting. Drive Genius can be used to add, initialize and delete partitions from your hard drive. Drive Genius can do volume and device copying. Drive Genius is able to hide partitions from most users. In addition, Drive Genius has the ability to move a partition on the hard drive and even sports a sector editing function to edit the data on any sector of the drive. Last but not least it has a shredding feature that erases drives securely per the Department of Defense's standard.
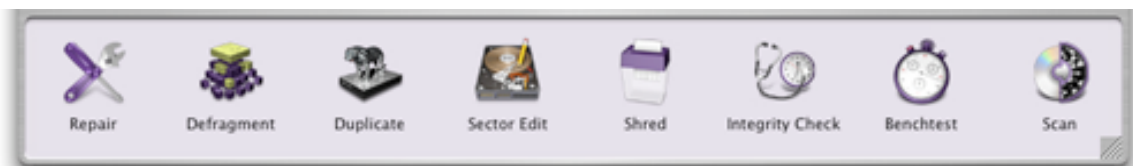
Drive Genius' tool palette

Latest version of the software

http://www.prosoftengineering.com

Check our web site to find out if you have the latest version of this software.

If you do not have the latest version of Drive Genius, download it from the web site using your serial number.

Program Setup

On the CD-ROM, you will find Drive Genius in the application folder. Drag the Drive Genius folder onto your hard drive. The first time you launch the software, enter your serial number and click on OK.

Uninstalling the Software

To remove this software from your hard disk:

1. Run uninstall from the Drive Genius menu
2. Move the Drive Genius icon to the Trash.
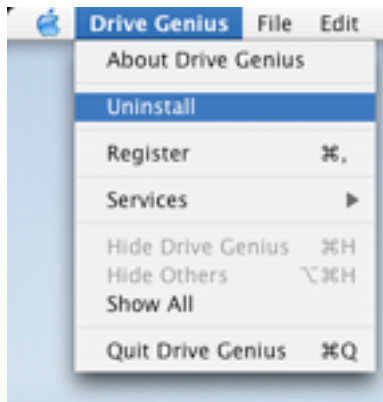
Contacting Prosoft Engineering

If you have comments about this product, problems or questions about this user guide or with our web site – or if you are interested in a site license – please contact PROSOFT ENGINEERING (please specify the version and serial numbers of your copy):

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Drive Genius Features

Drive Genius is designed from the ground up specifically for Mac OS X.

Drive Genius optimizes drive performance, protects data and provides easy-to-use yet powerful features for your storage needs. Drive Genius can defragment a volume, analyze a volume and repair it if necessary. Its testing capabilities go a few steps above other drive utilities with media surface scanning and long term data integrity checking.

Written specifically for Mac OS X, Drive Genius includes powerful features that give the user greater flexibility and control in setting up and managing your hard drives.

Analyze, Repair and Rebuild OS X directory information.

Defragment OS X drives for optimum performance.

Create high-speed backup clones of most devices.

Edit devices, volumes and files with the sector editor.

Securely erase drives using U.S. DoD specification algorithms.

Long range throughput tests for performance and diagnostics.

Benchtests for comparing drive performance.

Surface scanning to test for media faults.

Detailed reports on drive and volume structure information.

Format a comprehensive range of drives in OS X format.

Resize partitions without erasing them.

o Comprehensive Support including ATA, SCSI, Firewire and USB drives.
o Streamlined User Interface allowing most operations to be
   accomplished in a few clicks.
o Bootable CD-ROM support ranging from
   first generation iMacs to the latest PowerBooks.

Steps to Complete a Task

Most Drive Genius functions require a three-step process to complete a task:
1. Select a hard drive or volume in the main window.
2. Select an operation.
3. Select a parameter and apply it to the drive or volume.

Selecting a hard drive or volume

On the main windows, you can select the drive you want to work on. Use the scroll bar to view additional drives connected to your Macintosh. Once you locate the drive or the volume, you can select it by highlighting the drive or the volume.

Selecting a drive to work with

Selecting an Operation

Once you select the volume or partition to work on, you can select a task you want to perform by clicking on one of the icon buttons on the bottom panel of the main window.
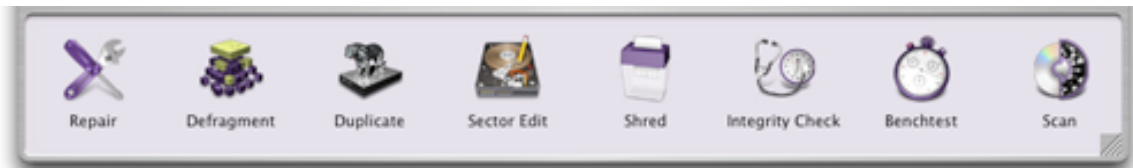
Drive Genius' tool palette

For operations such as copying, partition resizing and sector editing, you will need to enter additional information pertaining to the operation. Shredding, get details, benchtest, integrity testing and initialize don't require any additional information. Once you enter the parameters for the operation, click the Drive Genius icon to complete the task.

Prosoft recommends backing-up your data before using many features in Drive Genius and regularly; that way, if anything goes wrong (virus, power blackout, OS error or hardware failure etc…), you will be able to recover your data.

Repair is a tool for verifying and repairing most kinds of hard drive faults. It analyzes the volume for a general overview and can repair/rebuild the volume. It can also be used to enable and disable Apple journaling and fixes OS X file permissions on your boot volume.

Repair should be run whenever excessive system crashes occur. It also pays to run this periodically as it is not unusual for minor faults to appear on a hard drive.
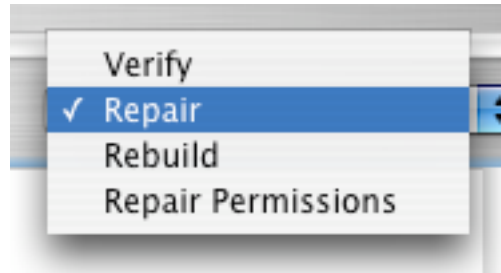
Repair Window

Options for drive repair

- o **Verify**: Check a volume for errors.
  Runs a general scan over the volume to detect any errors.

- o **Repair**: Check for and repair any found errors on a volume.
  Checks the volume for any errors, and attempts to repair them if they are found. If the volume has been having serious problems, it is recommended to repeat Repair until it stops reporting that errors have been fixed.

- o **Rebuild**: Rebuild the drive table that holds the file information.
  This will rebuild the portion of the drive (known as the Catalog B-Tree) that contains information pertaining to the location of all of the files on the volume. It is a separate utility from the Verify and Repair functions and may be used separately to repair faulty volumes. Since it rebuilds the structure based on the existing content of the rest of the drive, it can potentially fix errors that Repair tools cannot.

- o **Repair Permissions**: Correct the ownership and permissions according to Apple specifications. Repair Permissions will correctly set the permissions to solve most of problems related to permission issues.

Repair does not verify any physical media defects. Please use the Scan function of Drive Genius to check for media errors.

To **Repair** your drive:

Launch Drive Genius by double clicking on it.
Select the volume you want to repair by highlighting it.

Selecting the volume to repair

Click the ![icon] button on the bottom.
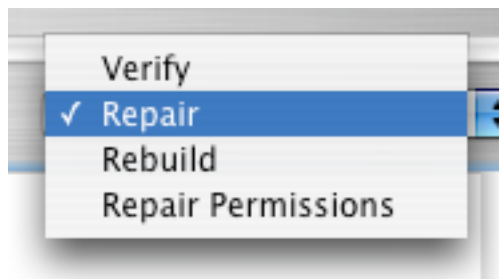
To **Repair** a volume:
Select from the popup menu whether you want to verify, repair, rebuild the volume, or repair permissions.

Options for Drive Genius' repair feature

Click the button to proceed.

To cancel, click on the button.

 The repair feature should not be used as a substitute for regular backups of your important data.

Journaling - Apple's journal file system keeps a log of the hard drive's main data activity. In the case of a crash or other system failure, the file system can retrieve lost data by consulting the "journal" log, restoring the system to its previous state instead of having to go through the lengthy process of rebuilding it. It is important to note that enabling Journaling can potentially slow drive access time down by up to 10%, but can be preferable in situations where data stability is more important than drive access speed.
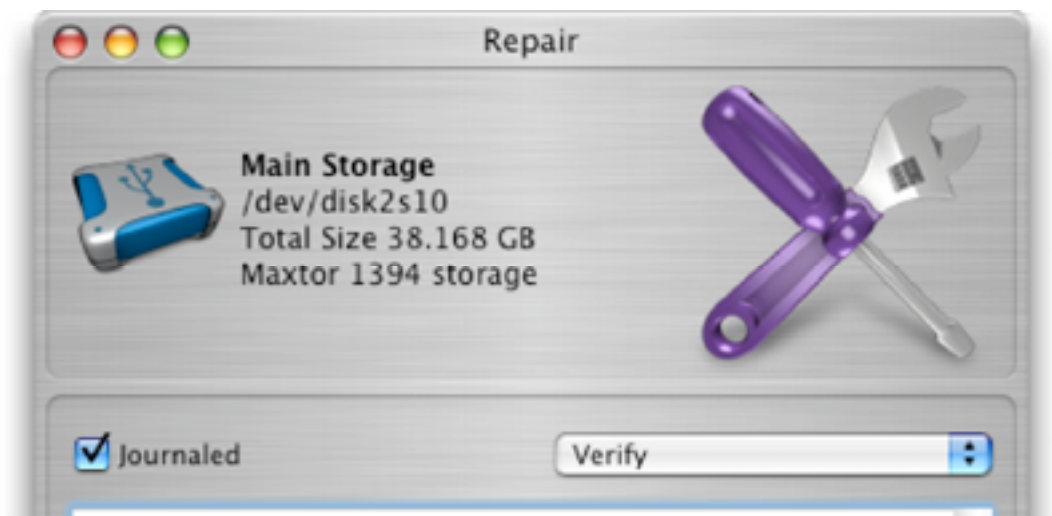
External drive with the journal system turned on

To turn journaling on/off:

Launch Drive Genius
In the volume view, select a mounted volume you want journaling to be turned on/off.

Click the icon on the bottom of the window.

From the Repair window, check or uncheck the Journaled check box to turn journaling on or off.

DEFRAGMENT

Adding and deleting files to and from your hard drive will cause the drive to become fragmented. When the OS writes files to the drive, it will look for empty spaces on the hard drive to write data to. If the space is too small to fit the file, it will write part of the data in one area and the remaining to another area. This way no disk space is wasted. However, this will cause the drive to slow down, as it will need to scan multiple parts of the drive to locate and read the file.

The more writing and deleting you've done to your drive, the more fragmented the drive will be. The process will gradually have an impact on the drive performance. This is why using Drive Genius to defragment your hard drive is an excellent way to boost the performance of your computer. Drive Genius puts all of these broken up pieces into one continuous block with all of the empty space at the end.
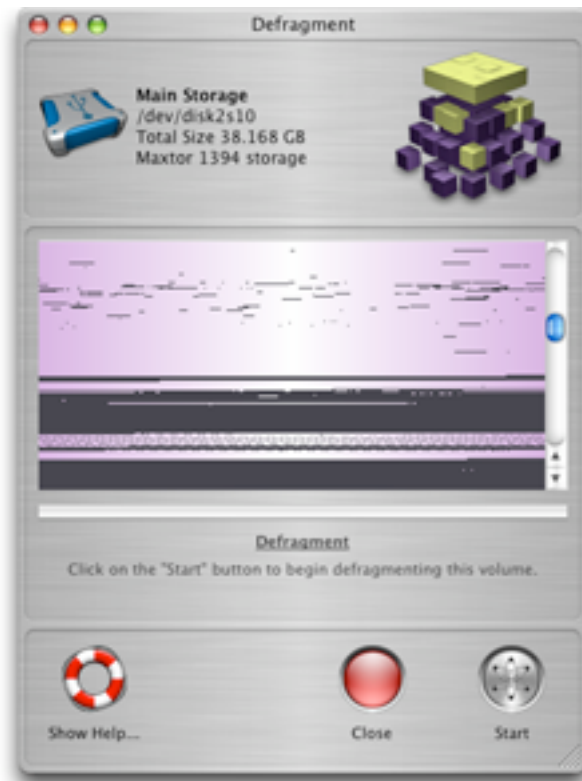
Defragment Window

To **Defragment** your drive:

Launch Drive Genius by double clicking on it.
Select the volume you want to defragment by highlighting it.

Selecting the volume to defrag

Click the button on the bottom.
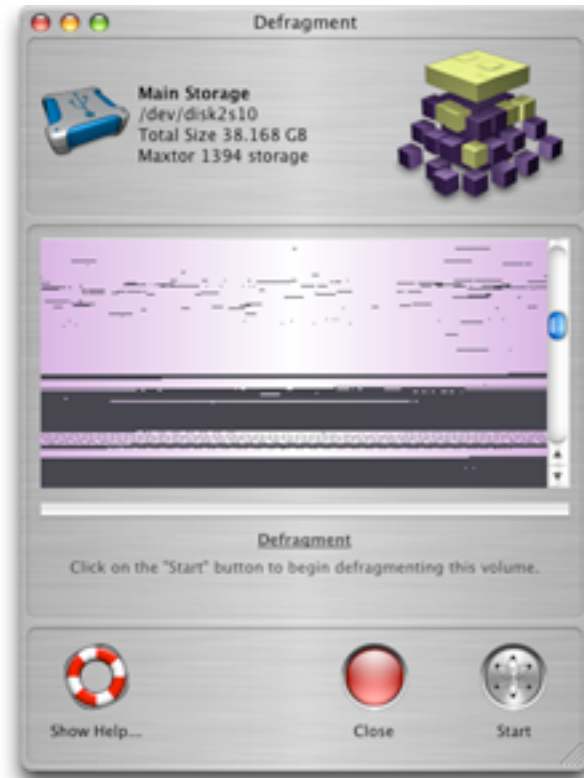
The Defragment Window

Click the button to proceed.

To cancel, click on the button.

Before defragmenting the drive, Drive Genius will ask to verify the volume's integrity.

Click the button to proceed.

To cancel, click on the button.

The repair window enables you to verify, repair and rebuild the volume.

Verifying the integrity of the volume

Click the button to proceed.

To cancel, click on the button.

Once the volume integrity is verified, the defrag process begins.
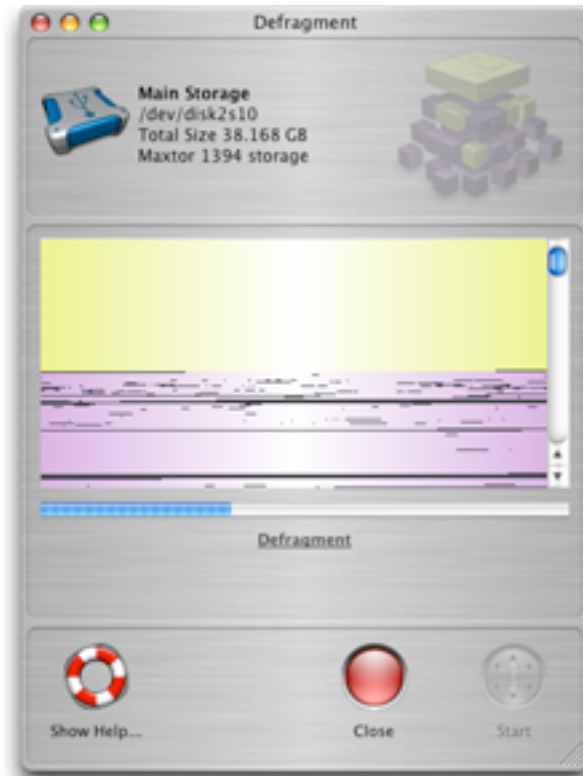
Defrag in progress

The screen shows the fragmentation of the volume:
- o   The yellow portion represents the data has already been defragmented.
- o   The lavender portion represents file that hasn't been moved yet.
- o   The black portion represents the free space.

It can take from half an hour to a day to defrag a high capacity drive (depending on how fragmented it is). The end of the day is a great time to kick this maintenance routine off.

DUPLICATE

The **Duplicate** function copies all the information from the source drive to the destination drive. A copy of the source drive is made to the destination, so if you backup your startup drive, a bootable copy of it is created, with all information such as file permissions preserved.

Unlike most backup programs which copy file-by-file, Drive Genius utilizes a method called device copy. Using device copy enables you to retain every detail of the original drive, from bootablity to the icon locations. Device copy is also a lot faster than the traditional file-by-file backup.

Drive Genius supports duplication of drives and volumes. For drive copy, Drive Genius will duplicate an identical copy of the drive. For volume copy, an identical volume is first duplicated, and then Drive Genius will apply a proprietary resizing technology to expand the volume size to the maximum, so no space is wasted.

Duplication can be to another drive or to a disk image file.

The Duplicate Window

To **Duplicate** your volume:

Launch Drive Genius or boot from the Drive Genius CD.
In the Drive Genius Volume window, select the volume you want to backup.

Selecting a volume to duplicate

Click the   icon.

The **Duplicate** window opens.

The Duplicate window

Select the target volume from the popup menu.

Click the ⬡ button to proceed.

To cancel, click on the ⬤ button.

> 📢 The information on the target drive will be replaced with the information on the source volume. If you want to archive to a file instead then select "New Disk Image" as the target.

To **Duplicate** a device:

Launch Drive Genius or boot from the Drive Genius CD.
In the Drive Genius Device's window, select the device you want to clone.

Selecting a device to duplicate

Click the   icon.

> The destination drive's existing partitioning scheme is affected by the Duplicate operation. All data that was previously stored on the destination disk will be replaced with the data from the source disk.

If you want to archive to a file instead then select "New Disk Image" as the target.

DUPLICATE

Duplicate window for devices

Select the target device from the pop-up menu.

Click the button to proceed.

To cancel, click on the button.

Drive Genius requires the source and the target devices to be unmounted before proceeding with the duplication. You will need a Drive Genius bootable CD or start up from another drive.

Drive Genius' **Sector Edit** allows expert users the ability to access and modify bits and bytes of a volume or a disk.

Sector Edit Window

Do not use this function unless you are extremely proficient with raw hex data. Editing the data using Sector Edit may render your data files unreadable, or even corrupt your drive.

To perform a low level **Sector Edit** on your drive:

Launch Drive Genius, or boot from you Drive Genius CD.
In the Drive Genius Volume window, select the volume you want to perform a sector edit. You can also perform sector edit on a device by selecting a drive under device view.

Selecting a drive for sector edit

Click the ⬜ icon.

> You can use the sector edit window on any file by using the file menu to open a document.

Sector Edit window

To navigate to the sector you want to edit, you have three options to accomplish that:

1. Type in the Sector number.
2. Use the slider.

3. Use the and arrows.

To modify the bytes, highlight the byte or bytes you want to modify, and type in the new value.

Sector Edit window

To apply the sector edit modification, click on the icon.

Prosoft recommends backing-up your data before using Sector Edit; that way, if anything goes wrong (virus, power blackout, OS error or hardware failure etc…), you will be able to recover your data.

Drive Genius **Shred** function is used for securely erasing the contents of a volume or the whole drive. There are many reasons to perform a shredding operation instead of simply dragging the files into the trash and emptying it. For example:

o   To avoid identity theft and protect your credit.
o   Stop intellectual property theft.
o   Permanently get rid of your data files so no one can recover it. For example, a volume with adult oriented materials.
o   Permanently remove any software that you are going to be using on your new machine since software licenses usually only apply to one computer.
o   Most Government/large corporations require the drives to be securely erased before disposing or transferring to other users.

The only secure way to erase your drive is by writing repeated passes of various data patterns. Drive Genius has been written to conform to the United States Department of Defense standards for drive sanitation.

Shred Window

Shred overwrites the volume or the drive with three passes and ensures all previous data will never be recoverable. Drive Genius's Shredder function conforms to the U.S. Department of Defense standard for drive sanitization (DoD 5220.22 M), and it works with IDE (ATA), SCSI, USB, and Firewire hard drives. The current version of Shredder does not support RAID drives.

Note: US Department of Defense in the clearing and sanitizing standard DoD 5220.22-M recommends the approach "Overwrite all addressable locations with a character, its complement, then a random character, verify for clearing and sanitizing information on the writable media".

Drive Genius can shred either a volume or the whole drive. If you are shredding your boot volume or your startup drive, you will need to boot the system from the Drive Genius CD, or boot of from another drive with Drive Genius installed.

Shred Window

To run **Shred** from the Drive Genius CD:

1. Turn on your Macintosh and insert the Drive Genius CD.
2. Press and hold down the letter "C" key.
3. Release the "C" key after the CD starts booting.
4. Drive Genius will automatically appear on your screen.
5. Enter the registration information.
6. From the volume view, select the volume you want to shred.

Selecting a volume to shred

Click the   icon.

SHRED

Shred Window

Click the button to proceed.

To cancel, click on the button.

After the operation, a newly initialized HFS Plus partition will appear on the desktop.

When you are done with shredding, quitting Drive Genius will restart the computer. Press and hold (unless other method specified) the mouse button to eject the Drive Genius CD during restart.

To run **Shred** from your hard drive:

1. Launch Drive Genius.
2. From the Volume view, select the volume you want to shred.

Selecting a volume to shred

Click on ⬚ icon.

SHRED

Shred Window

Click the button to proceed.

To cancel, click on the button.

After the operation, a newly initialized HFS Plus partition will be mounted.

Integrity Test is a suite of diagnostics designed to test the overall integrity of the disk drive by writing and reading various block sizes to and from the drive. By reading, writing and comparing the read and write data, Integrity Test measures and reports various aspects of the drive subsystem including the driver, the drive controller, the cabling, the drive's motherboard and the head seek mechanism.

To use Integrity Test on a volume/device:

Launch Drive Genius by double clicking on it.
Select the drive you want to test by highlighting it.

Selecting the volume to test

Click the button on the bottom

Options for **Integrity Test** Settings
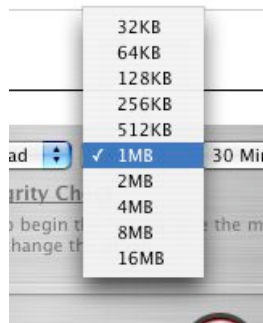
Transfer Size

The transfer size ranges from 2 KB to 16 MB. For setup such as mail server or accounting server, test the drive at 2 KB block. Database servers do lots of little searches and hardly ever read lots at a time so small blocks are a good test. Use a bigger block size if you use the drive for graphic intensive application and digital audio and video applications.
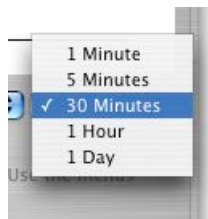
Test Duration

The length of test can be varied from one minute to one day. The longer the duration given to the test, the more reliable the results are. Start with smaller time frames and give it a longer period to detect more subtle flaws.

Test type

- ○ **Sequential read -** test measures how many times single-block reads can be performed in one second.
  This test is affected by read caching (the larger the read cache, the faster the performance).
- ○ **Sequential write -** test measures how many times single-block writes can be performed in 1 second.
  This test is affected by write caching (the larger the write cache, the faster the performance).
- ○ **Random read -** test measures drive performance for reads of blocks of data from 2 kilobytes to 16 megabytes. For small block sizes, seek time and rotational latency are weighted more heavily. For large block sizes, the transfer rate is weighted more heavily.
- ○ **Random write -** test measures drive performance for writes of blocks of data from 2 kilobytes to 16 megabytes.
  For small block sizes, seek time and rotational latency are weighted more heavily. For large block sizes, the transfer rate is weighted more heavily.
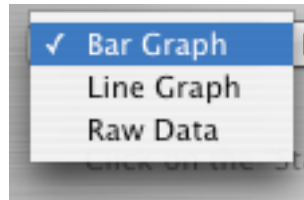
Selecting a graph type

Graph Type: Allows you to select the graphical way that the information related to the speed of the operations is displayed.

There are three ways to display the data:
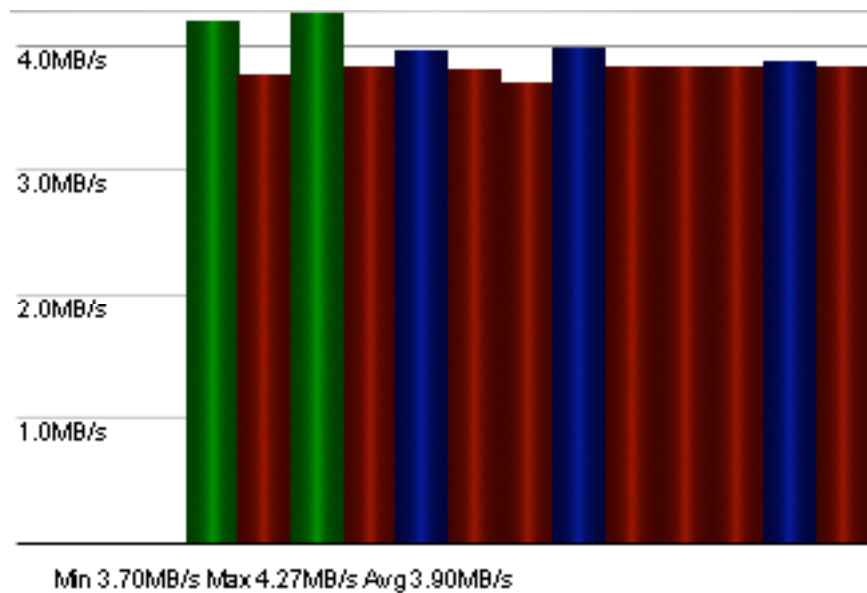
Bar graph

Min 3.70MB/s Max 4.27MB/s Avg 3.90MB/s
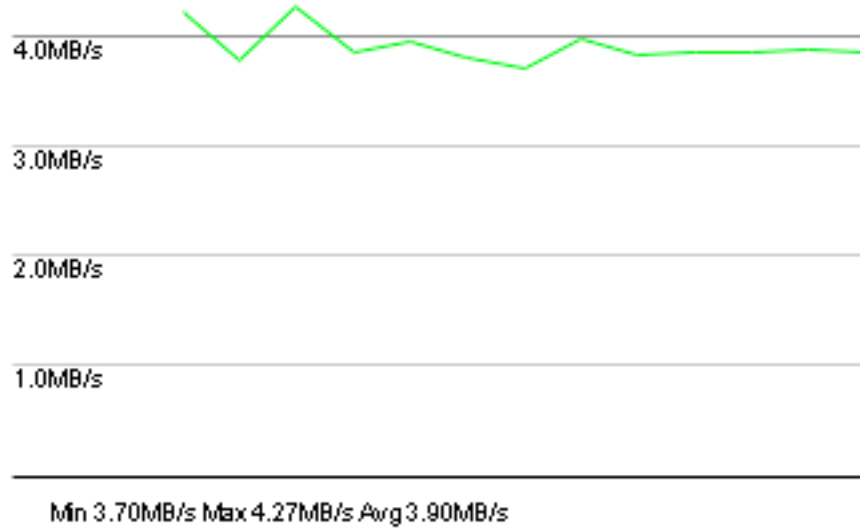
Line graph

3.83 Megabytes per second
0.26 Seconds per Megabyte

Min 3.70MB/s Max 4.27MB/s Avg 3.00MB/s

Raw data

Benchtest is a tool to test the performance of different drivers, CPU's, operating systems, and data-transfer efficiency of large and small volumes. For example, digital video users can use Benchtest to see how differing custom driver and mode page settings affect the efficiency of video capture and web server administrator can find out how the volume performs under small file transactions.

Benchtest reports the results in either graphical or numeric formats. You can export the results as high quality images, or save them as files. You can also import files that others have saved and Drive Genius comes with a set of them from most current Macintosh systems. You can select these for a live on-screen comparison between your system and others.
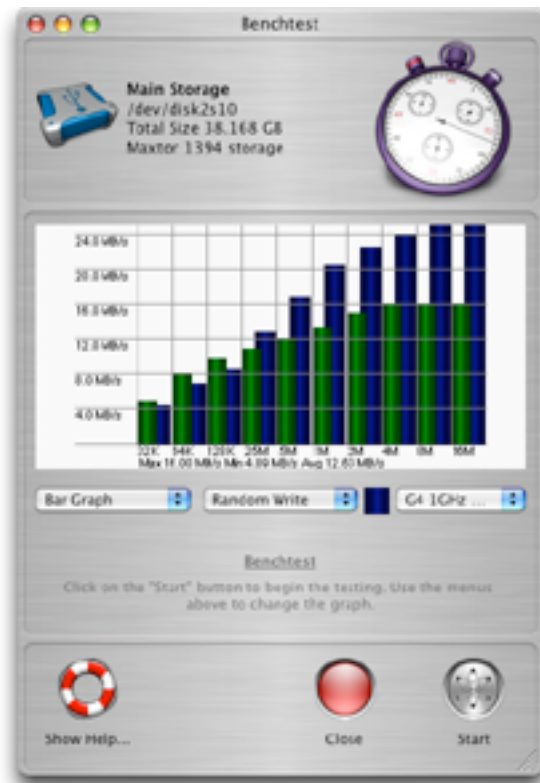
Benchtest Window

Benchtest will perform the following tests on the drive selected:

o **Sequential read** test measures how many times single-block reads can be performed in one second.
 This test is affected by read caching (the larger the read cache, the faster the performance).
o **Sequential write** test measures how many times single-block writes can be performed in 1 second. This test is affected by write caching (the larger the write cache, the faster the performance).
o **Random read** test measures drive performance for reads of blocks of data from 2 kilobytes to 16 megabytes.
 For small block sizes, seek time and rotational latency are weighted more heavily. For large block sizes, the transfer rate is weighted more heavily.
o **Random write** test measures drive performance for writes of blocks of data from 2 kilobytes to 16 megabytes.
 For small block sizes, seek time and rotational latency are weighted more heavily. For large block sizes, the transfer rate is weighted more heavily.

To **Benchtest** your drive:

Launch Drive Genius by double clicking on it.
Select the drive you want to benchtest by highlighting it.

Selecting the volume to repair

Click the button on the bottom

Depending on the speed of the drive and the CPU, it may take up to ten minutes to finish the test. The test data is updated as soon as each task is completed.

A status bar marks the progress of the test. You can click on the Red button to stop and exit from a test in progress. It may take a few seconds before the test is cancelled.

Depending on the display option you selected, the final result can be in the form of a bar chart, line graph or formatted text.
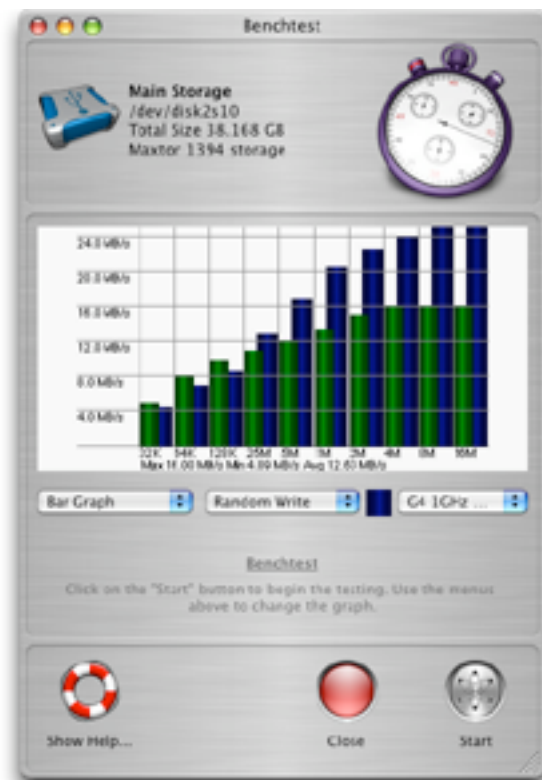
Benchtest window with test results displayed

The graph depicts the read/write performance (vertical axis) in relation to transfer size (horizontal axis).

To get the most accurate test results, we recommend that you do not run the Benchtest in the background. Avoid running other CPU intensive applications in the background as this may also affect the results.

When the test is completed, Drive Genius automatically displays its results. You can save the Benchtest results by selecting Save from the File menu. The saved results will be added to a results folder and can be retrieved for future comparisons.

There are various selections to display the test results:

Test Display - Drive Genius performs the following tests: Sustained Read, Sustained Write, Random Read and Random Write. To display any of the tests above, simply select it from the pop-up menu.

Selecting test to be displayed

Comparisons - Drive Genius gives you the ability to compare to other drives as the test is being run and it includes many sets of test data. To select other drives for comparison, click on the Comparison Device pop-up menus on the lower half of the Benchtest window.

Selecting the drive to compare to

Graph Types - Once you have the test results, you can select from a pop-up menu to display the data in various formats. There are three ways to display the data:
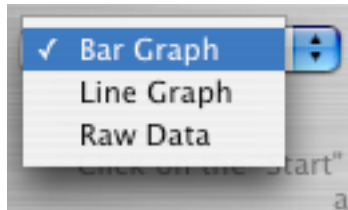
Selecting the type of graph to draw
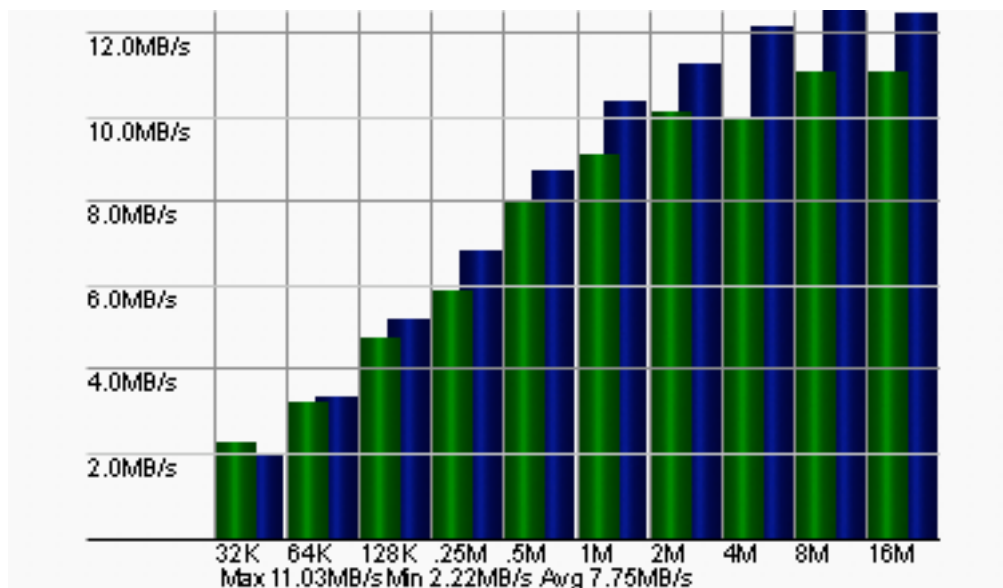
Bar graph *- Draws a bar graph comparing your drive with your choice of a comparison drive.*
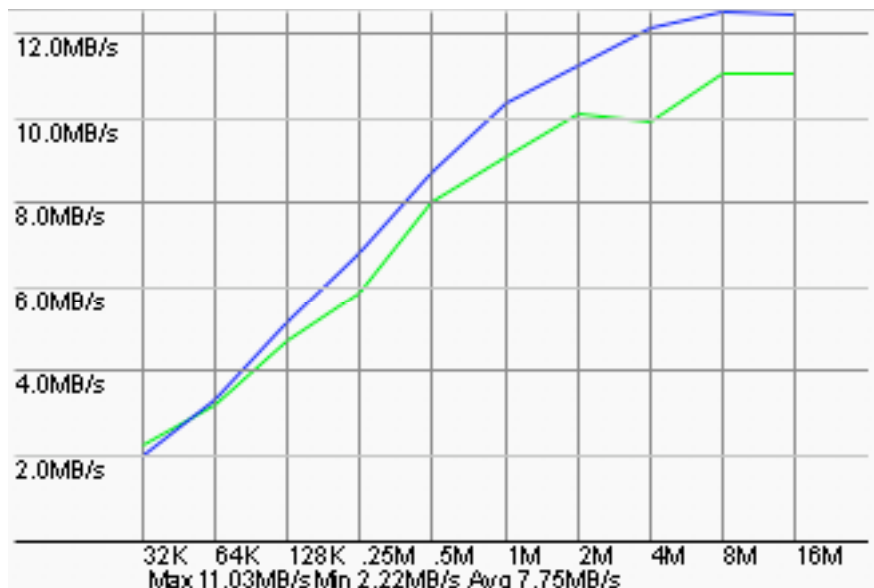
Line graph - *Draws a line graph comparing your drive with your choice of a comparison drive.*

32K	2.22MB/s	1.977MB/s
64K	3.205MB/s	3.339MB/s
128K	4.729MB/s	5.147MB/s
256K	5.836MB/s	6.784MB/s
0.5M	8.033MB/s	8.688MB/s
1.0M	9.1MB/s	10.378MB/s
2.0M	10.105MB/s	11.228MB/s
4.0M	9.948MB/s	12.152MB/s
8.0M	11.034MB/s	12.549MB/s
16.0M	11.034MB/s	12.468MB/s

Raw data -- *Displays the numerical figures rather than representing the information graphically.*

Drive Genius **Scan** is designed specifically to verify that every sector (block which can contain information) on your volume or drive can be read correctly. It is recommended to run this test if you notice abnormal sound emitting from the drive, or the Finder reports some of the files cannot be copied. Drive Genius Scan tests all of your drives data space.

Data on a hard drive is stored in a series of blocks. In usual operation every block of the drive should be able to be written to and read from again. However sometimes a hard drive can develop a problem where one or more blocks may lose storage capacity and become unreadable. Surface Scanning is the process of requesting a read on every block on the drive in sequence and determining if the drive reports an error on any of these requests. If there are any errors, Drive Genius reports them to you live as it is scanning.

The time required for a Scan test is dependent on the drive's capacity and rotational speed. The blocks are read in sequential order and the operation is performed on all blocks. Drive Genius will not remove bad blocks. If Drive Genius reports any bad block, you may need to reformat the drive with Drive Utility that comes with Mac OS.

To **Scan** your drive:

Launch Drive Genius by double clicking on it.
Select the volume you want to scan by highlighting it.

Selecting the volume to scan

Click the button on the bottom

Scan window

Click the [image] button to proceed.

To cancel, click on the [image] button.

To get **Details** on your drive:

Launch Drive Genius by double clicking on it.
Select the volume you want to get details on by highlighting it.
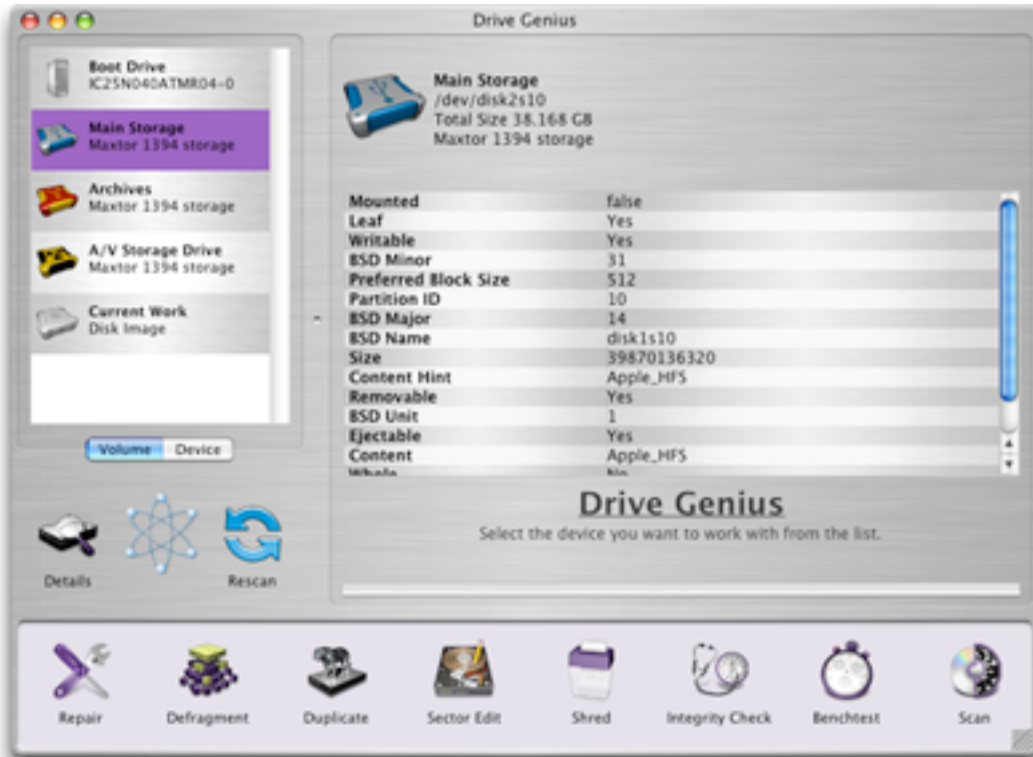
Selecting the volume to detail

Click the [ ] button on the bottom.

The Details window will open, displaying info of the volume such as name, total blocks, partition ID and information that expert users will find useful.

The Details Window

To close this, click on the [button image] button.

Use the File Menu or press command-s to save the detail to a text report. This information can be helpful to support people and for reference.

Drive Genius's **Initialize** feature is the easiest way to prepare a disk for general use. Most hard drives are already formatted at the factory. However, almost none of them are ready for Mac use yet. Initialize will:

- o Install the Apple driver
- o Write a partition map
- o Create a new volume and mount it to the desktop

Initializing will wipe out the first few thousand blocks of the drive in order to place a device driver and the partition map on the drive. The rest of the drive is intact but files that were previously on the drive will not be accessible any more. If you accidentally initialize a drive and it contains information that you did not backup, you will need software such as "Data Rescue" or "File Salvage" to recover the files.

If you are initializing your boot drive or you only have a single drive connected to your system, you will need to boot the system from the Drive Genius CD.

The initialize window

To **Initialize** your drive:

Launch Drive Genius by double clicking on it.
Select the drive you want to initialize by highlighting it.

Selecting the drive to initialize

Click the button on the bottom

The initialize window

Click the _____ button to proceed.

To cancel, click on the _____ button.

When you are done with initializing the drive, quitting Drive Genius will restart the computer. Press and hold the Mouse button to eject the CD during restart.

Repartition enables you to resize and manage partitions (volumes) on your hard drives. Unlike traditional methods of backing up, erasing and repartitioning the drive, Drive Genius allows you to expand or shrink partitions without erasing them. In less that a few clicks, Drive Genius will defragment and resize your partition to the size of your choice. You can use the Repartition feature to create and delete partitions. Drive Genius includes many custom icons that can be automatically applied to your newly created partition. The Repartition feature can hide partitions from users as well. Last but not least, the feature also has the ability to shift a partition on the hard drive in addition to reconstructing partition maps.

Drive Genius' Repartition window

We have made Repartition a feature that is extremely easy to use. However, we strongly recommend you read the following few sections. The Repartition feature is extremely powerful and will have a negative effect on your drive if not used correctly.

REPARTITION

To run **Repartition** from your hard drive:

1. Launch Drive Genius.
2. From the Device view, select the drive you want to repartition.

Selecting a drive to repartition

Click on the   icon.

Repartition is designed to work with OS X partitions. Using it on OS 9 volume may remove the ability to start up OS 9 from that partition. It does not affect the data on OS 9 volumes at all.
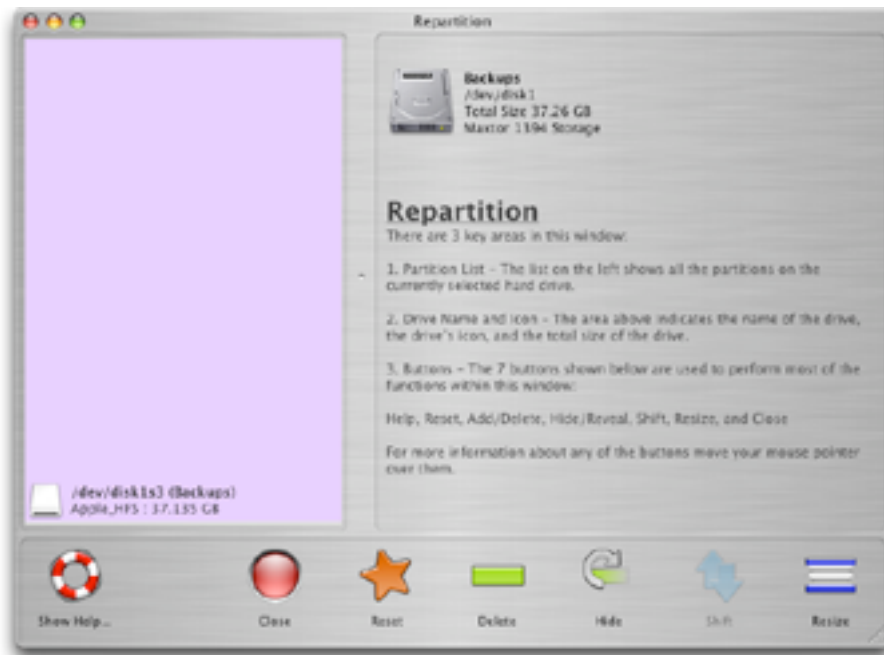
Drive Genius' Repartition window

There are 4 key areas in the main window:

Partition List - the list on the left hand side of the screen shows all the partitions on the currently selected hard drive. The example above shows 2 Apple HFS partitions (standard OS X volumes) named Android 17 and Android 18 and 1 partition that are allocated as free space (light blue icon). Free space contains no data. The partition list will also show hidden partitions and partitions with file systems not supported by the OS.

Drive Name and Icon - the upper right hand corner indicates the name of the drive, the drive's icon and the total size of the drive.

Context-sensitive help - provides help and descriptions of the current active screen and the icon buttons.

Prosoft recommends that you back up your data before using Drive Genius; that way, if anything goes wrong (virus, power blackout, OS error, or hardware failure etc…), you will be able to recover your data.

Icon Buttons - the 7 icon buttons shown at the bottom right hand corner of the main window are used to perform most of the functions within the program:

Provides information on Drive Genius' features and step-by-step instructions for performing specific tasks.

Resets the partition map to regain the extra space wasted during a hardware device-to-device copy.

Add a new volume to the drive.

Delete a partition from your drive.

Hide partitions on your drive.

Reveal partitions on your hard drive.

Shift volumes without requiring you to erase them.

Resize (expand or shrink) your OS X partitions without requiring you to erase the volume.

Close the current window.

Resize allows you to resize your OS X disk partitions (volumes) without requiring you to erase the volume. Partitions can be shrunk in order to make room for a new partition, or they can be expanded to take advantage of free space on the drive.

To shrink a volume:

On the Repartition window, select the volume/partition you want to work by clicking and highlighting it.

Click the ⬚ button.

You will be presented with the dialog as shown below.

The Resize sheet

Use the slider to select the new size of your partition and press the "Drive Genius" icon to continue. You can also type in the new size of the partition. Please note that you cannot make a volume smaller unless it has unused space.

If you are shrinking a partition and the data needs to be defragmented, a new window will pop up for the defragmenting process.
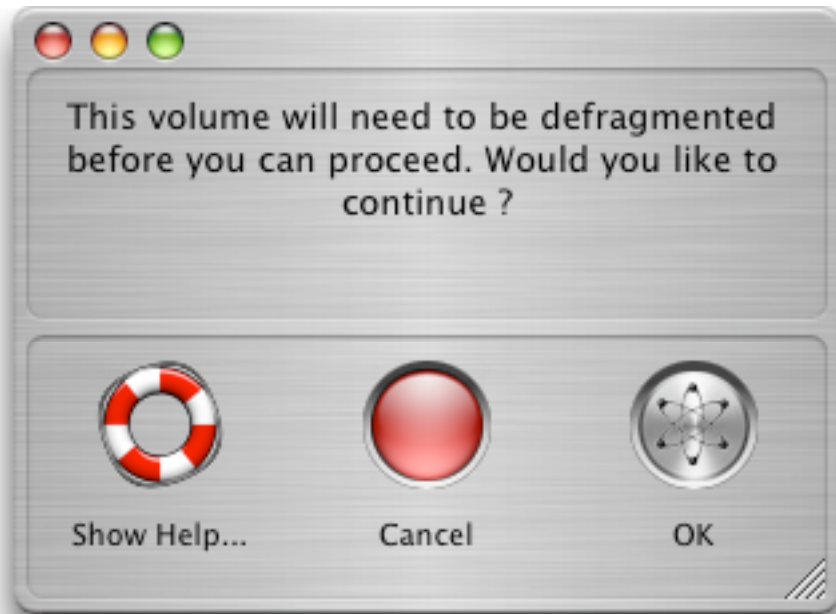
This volume will need to be defragmented before you can proceed. Would you like to continue ?

Show Help...   Cancel   OK

Click the   button to proceed.

To cancel, click on the   button.

Before defragmenting the drive, Drive Genius will ask to verify the disk's integrity.
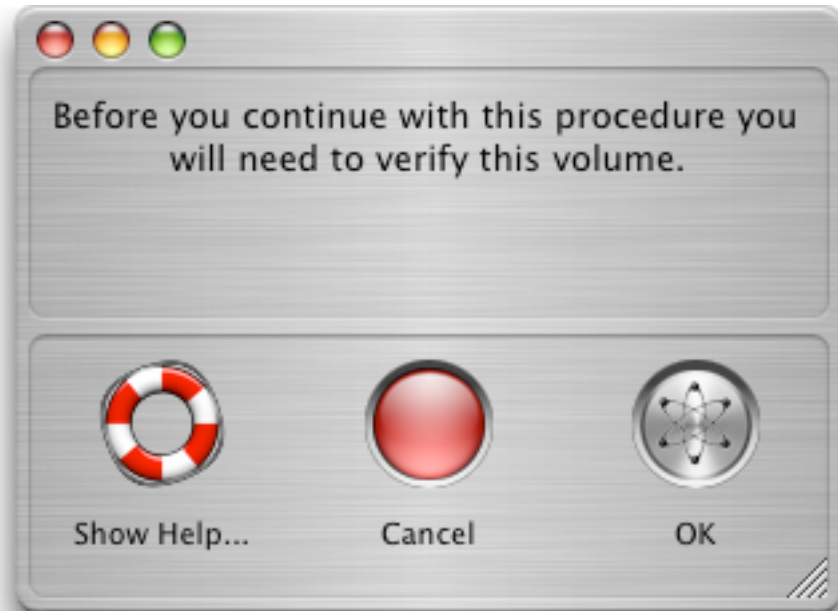
The Verify window enables you to verify, repair and rebuild the volume.

Click the button to proceed.

To cancel, click on the button.

The repair window enables you to verify, repair and rebuild the volume.

Verifying the integrity of the volume

Click the [button] button to proceed.

To cancel, click on the [button] button.

Once the volume integrity is verified, the defrag process begins.
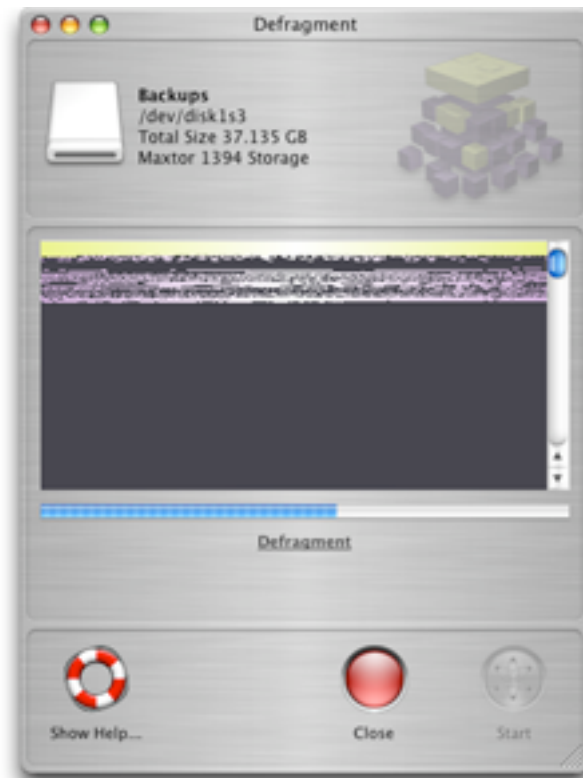
Defrag in progress

The screen shows the fragmentation of the volume:
- o The yellow portion represents the data that has already been defragmented.
- o The lavender portion represents fragments that haven't been moved yet.
- o The charcoal portion represents the free space.

It can take from half an hour to a day to defrag a high capacity drive (depending on how fragmented it is). The end of the day is a great time to kick this maintenance routine off.

After the operation is completed, Drive Genius will mount the resized partition on the desktop and a new free space partition will be present on the Repartition window shown below.

Volume is resized down

Prosoft recommends that you back up your data before using Drive Genius; that way, if anything goes wrong (virus, power blackout, OS error or hardware failure etc…), you will be able to recover your data.

To expand a volume:

Select the volume you want to expand by clicking on it.

Selecting a volume to expand

Click the button.

You will be presented with the window shown below.

Use the slider to select the new size of your partition.

After the operation is completed, Drive Genius will mount the resized partition on the desktop.

You will need to have free space below the volume you want to expand. You cannot expand a volume if there is no Apple_Free space below it. Use the 'resize' or the 'shift' feature to create free space in the appropriate place.

Drive Genius allows you to shift disk partitions (volumes) without requiring you to erase the volume. Partitions can be moved forwards and backwards on the hard disk allowing you to combine free spaces into one. When you shift a partition, the partition's data is unaffected. The free space adjacent to the partition will determine how far forward or backward you can move the partition. If there is no free space adjacent to it, the partition cannot be moved. Additionally, you cannot move an Apple_Free partition.

To Shift a Volume:

Selecting a volume to expand

Click the button.

You will be presented with the window shown below. If you want to shift the partition to take over the space below the current volume, click the Down Arrow icon button. To take over the space above the volume, click the Up Arrow icon.
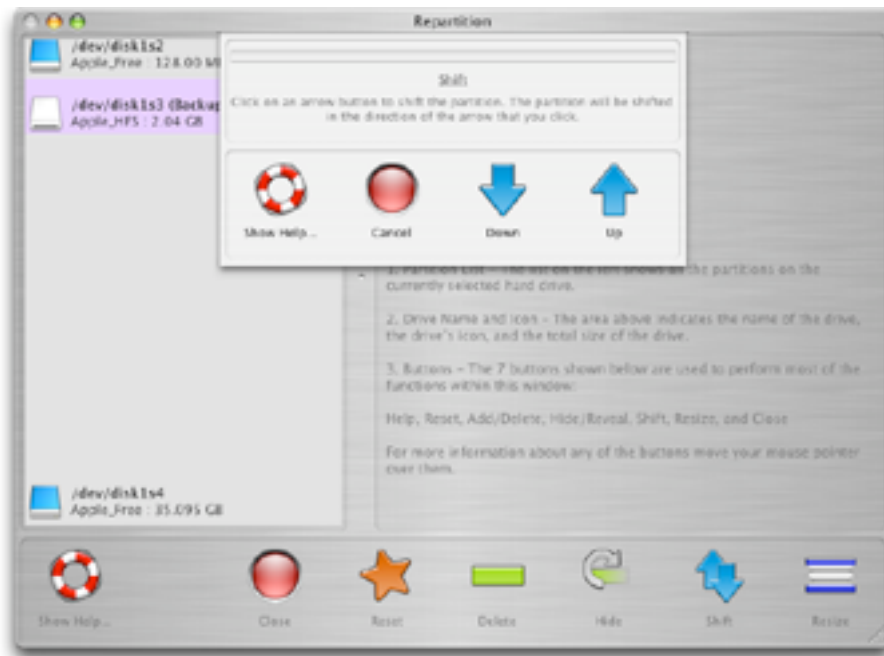
Selecting the direction of the shift

Once you have selected a direction you will be presented with the following dialog.
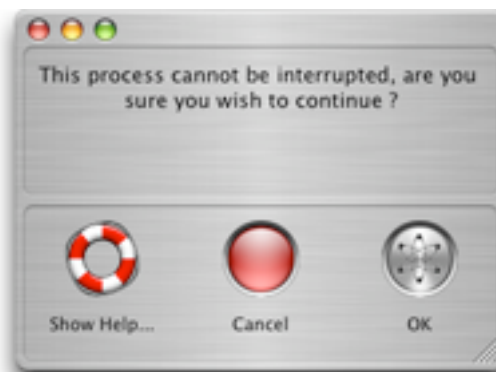
Click the button to proceed.
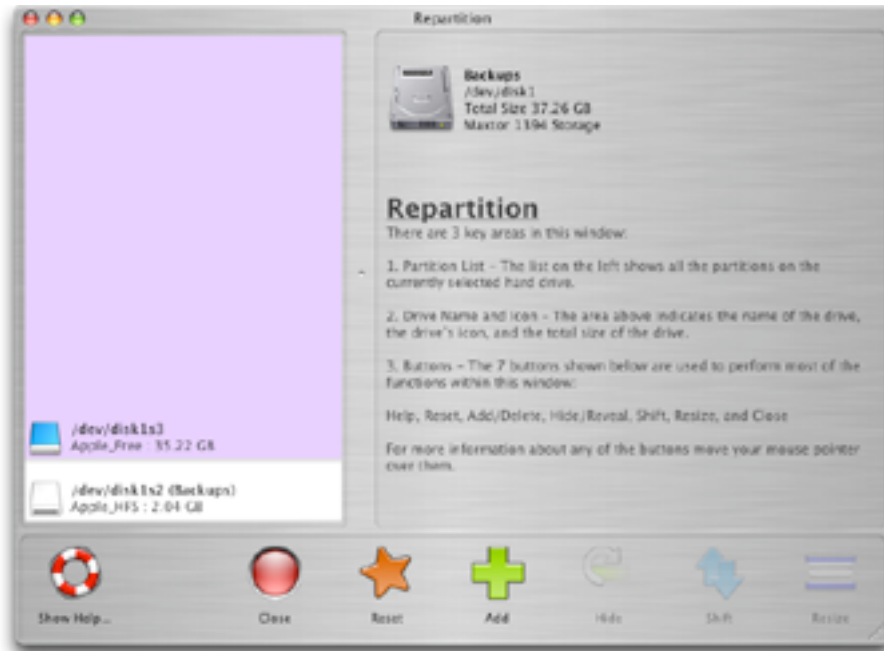
After the shift

Prosoft recommends that you back up your data before using the shift function of Drive Genius; that way, if anything goes wrong, you will be able to recover the data. Once started, the shift process cannot be interrupted.

Using Partition Shifting before expanding a volume

To expand a volume, you will need to have free space below the volume you want to expand. You cannot expand a volume if there is no Apple_Free space right next to it (or below it in the Repartition window). If the Apple Free_Space is on top of the volume you want to expand, you will need to shift the volume before expanding the volume. For example in the example below, you cannot expand the fourth partition since there is no free space below it.
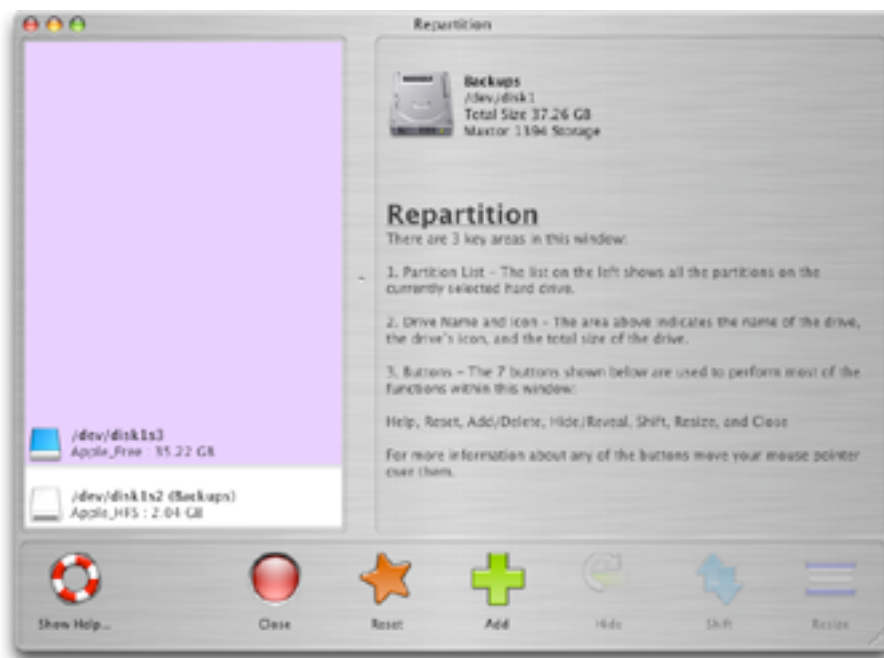
The second partition needs to be shifted

To expand the second partition, the first and the second partitions will need to be switched around. To do that, select the second partition and click the Shift icon button. Then click the Up Arrow to move the second partition upward. When completed, the newly moved partition can be expanded.

Creating and Deleting Volumes

Drive Genius allows you to create or delete a volume from your hard drive. The Delete operation deletes a volume and destroys all its data. This partition will be marked as "free space" until you create a new volume or expand an existing volume to take over it.

To delete a volume:

Select the volume you want to delete by clicking on it.

Click the   button.

Once you delete a volume, the data will not be available for further use.

To create a new volume, free space must exist on the drive. If there is no free space, you will need to use resize to shrink a current volume, to open up free space for the volume creation process.

To create a volume:

Select the free space partition or volume you want to create a new volume on.

Selecting a free space to create a volume

Click the ![plus button] button.

REPARTITION

Use the slider to select the new size of your volume and click the "Drive Genius" icon to continue. If you are running the application on the hard drive instead of the bootable CD, you can select an icon from a list of custom icons for your new volume (icons used with the kind permission of http://www.iconizer.com/).
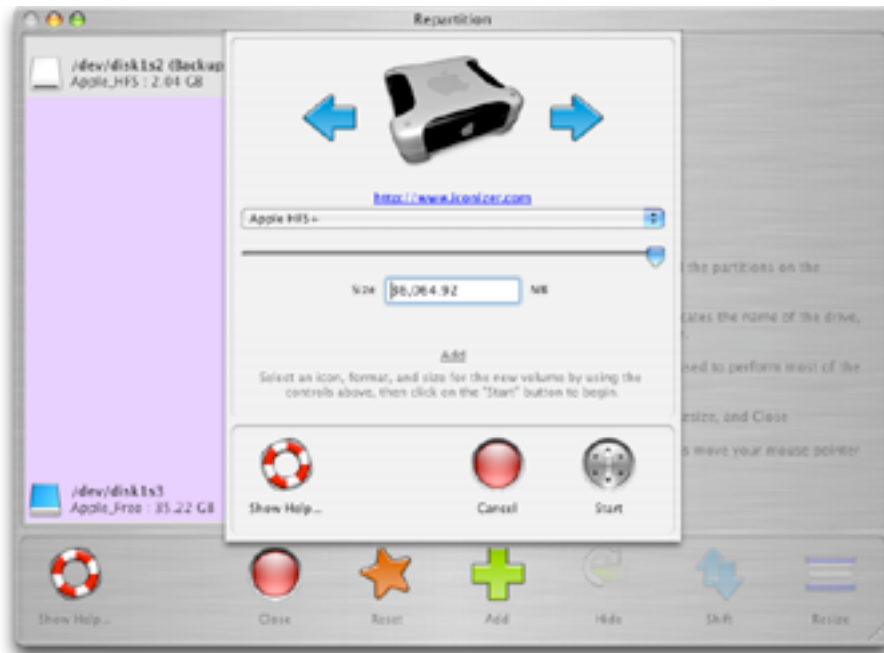
Create volume window

Click the ⚛ button to proceed.

To cancel, click on the 🔴 button.

Resetting the Partition Map

After performing device-to-device disk copy using hardware such as Disk Jockey™ from Diskology™, the partition map on your new hard drive will not allow full access to all the space. For example, if you use Disk Jockey to copy a 20 GB drive to a brand new 60 GB drive, the 60 GB drive will show up on the Macintosh as a 20 GB drive. Using Drive Genius to reset the partition map allows you to reclaim the 40 GB of extra space.

To reset the partition map:

Click the ⭐ button.

Before resetting the partition map

The picture above shows 1 partition on a hard drive. After resetting this partition map, then expanding the volume you will end up with the extra space as shown below.

After resetting the drive partition map

Hiding and Revealing Volumes

You can use Drive Genius to hide and reveal volumes on your hard drive. The Hide Volume operation allows you secure volumes against unwanted user access. Hidden volumes will not be visible under normal circumstances and will not mount automatically.

To hide a volume:

Click the   button.

After applying the hide function

To reveal a volume:

Click the   button.

Q. Can Drive Genius copy the active startup volume/device to another hard drive?
A. No, Drive Genius requires the source and the target volumes to be unmounted before proceeding with the duplication. Use the OS X boot CD to copy your main drive.

Q. Does the target volume/device have to be *larger* than the source volume/device?
A. Yes, the target volume has to be the same or larger than the source volume.

Q. Will Drive Genius report a problem if the source volume/device is corrupted?
A. No. Since Drive Genius uses a bit-by-bit copy, every problem will be copied over.

Q. Will Drive Genius Duplicate work with RAID?
A. No. The current version of Drive Genius will not be able to duplicate any RAID arrays.

Q. My SCSI drive was formatted with a 3rd party driver and has 4096 byte/sector, will Drive Genius be able to duplicate it to another SCSI drive?
A. No, Drive Genius only works with 512 byte per sector drives (this includes almost all drives) for now.

Q: Can I use Drive Genius to resize a UFS Volume?
A: No. Drive Genius can only resize HFS+ volumes.

Q: Can I use Drive Genius on OS 9 partitions?
A: Drive Genius is designed to work with OS X partitions. Using Drive Genius on OS 9 volume will remove the ability to start up OS 9 from that partition. Drive Genius does not affect the data on OS 9 volumes at all.

Q: I am trying to resize a volume on the startup disk, and Drive Genius gives an error with the message "Unable to unmount". What gives?
A: In order to modify a volume on the startup disk, you will need to startup from another disk, and run Drive Genius there. Alternatively, you can purchase a bootable CD from us.

Q: I have 2 partitions with data on my drive. Can I merge them into one partition?
A: Drive Genius cannot do volume merging for now. We are looking into adding the feature in a future version.

Q. Does Drive Genius 'partitioning without erasing feature' mean I do not need to backup my data?
A. Changing information on a volume involves some risk. Drive Genius endeavors to ensure that there is no possibility of data corruption during the resizing process. No safety system can beat the security of having a backup.

Q. If I hide a partition using Drive Genius, is the partition secure?
A. No, the partition can be easily made visible again by using Drive Genius. The hidden mode is designed as a simple/convenient way to hide your data from prying eyes. If you would like industrial strength disk encryption, we recommend SubRosaSoft CipherDisk.

Q. Where is the documentation for Drive Genius?
A. You are reading it now. If you need help while you are using the software, you can access the help file from the Help menu.

Q. I notice there are a few tiny partitions created on my HD when I ran Drive Genius partitioning feature. What are they for? What can I do with them?
A. Unfortunately, the small partitions were created by Apple (OS 10.3 or higher). We have no control over it. Disk Utility leaves big gaps between partitions both in front and behind the space used by volumes. Drive Genius exposes these tiny volumes when it works on the partition map. Drive Genius does not create them, and you can use it to expand a volume or two, to take over them.

Q. I need support help, what should I do?

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The following document is a discussion of optimization and defragmenting. The content of this is based on a web page apple publishes on their own site which can be found at http://docs.info.apple.com/article.html?artnum=25668

Drive optimization is a process in which the physical locations of files on a volume are "streamlined." Files and metadata are re-arranged in order to improve data access times and minimize time moving a hard drive's head.

Files can become "fragmented" over time as they are changed and saved and as the volume is filled, with different parts of a single file stored in different locations on a volume. The process of collecting file fragments and putting them "back together" is known as optimization.

Do I need to optimize?

You probably won't need to optimize at all if you use Mac OS X. Here's why:

Hard drive capacity is generally much greater now than a few years ago. With more free space available, the file system doesn't need to fill up every "nook and cranny." Mac OS Extended formatting (HFS Plus) avoids reusing space from deleted files as much as possible to avoid prematurely filling small areas of recently freed space.

Hard drive capacity is increasing. Real world analysis shows that users still operate close to their total capacity. File size is increasing at a rate seemingly higher than drive capacity is.

Regular use of a drive with the creation of media files from digital video cameras, multi mega pixel images from still cameras and higher quality music files can and will cause a drive to be operated near it's total capacity.

Mac OS X 10.2 and later includes delayed allocation for Mac OS X Extended-formatted volumes. This allows a number of small allocations to be combined into a single large allocation in one area of the drive.

Apple's innovation has greatly improved this process. It should be stated that in order for this to be successful it needs "a single large allocation in one area of the drive" It is for this reason that the defragment module of the Genius range of software focuses on creating exactly that.

Fragmentation was often caused by continually appending data to existing files, especially with resource forks. With faster hard drives and better caching, as well as the new application packaging format, many applications simply rewrite the entire file each time. Mac OS X 10.3 Panther can also automatically defragment such slow-growing files. This process is sometimes known as "Hot-File-Adaptive-Clustering."

This is correct. Fragmentation in the modern times is caused by the creation of larger files, then deletion, copying and moving of files. This has a tendency (caused by the "Hot-File-Adaptive-Clustering.") to create large chunks interspersed with smaller available allocation areas. The technology developed in the defragment module of the Genius range of software will move the file chunks in order to join the many free ranges into one larger range… ready for the next "Hot-File-Adaptive-Clustering."

Aggressive read-ahead and write-behind caching means that minor fragmentation has less effect on perceived system performance. Read-ahead caching is excellent at providing fast access to information that is contained in the same track or neighboring tracks to the data that was requested. It is not terribly useful on data that is fragmented randomly across the entire platter.

For these reasons, there is little benefit to defragmenting.

The new technologies added by Apple to the HFS+ file system are an excellent upgrade to the OS X operating system. To assist them has taken new thinking and new development for Apple and for third party developers.

The defragment module of the Genius range of software was designed specifically to augment the new capabilities of the OS X operating system. Particular focus has been placed in creating "a single large allocation in one area of the drive" as required by Apple.

Users who create and/or use large media files also benefit from "a single large allocation in one area of the drive" in which to create the new file.

Mac OS X systems have hundreds of thousands of small files, most of which are rarely accessed. Optimizing them is a major effort for very little practical gain. There is also a chance that one of the files placed in the "hot band" for rapid reads during system startup might be moved during defragmentation, which would actually decrease performance.

If you think you might need to defragment, try restarting first.

This is good advice (as always). This would also be an ideal time to boot from the Drive Genius CD to have a graphical view of file fragmentation given to you. It may also be a good time to use the volume duplicate function to create a backup of your important data.

To expand a disk in Windows XP after using **Device Duplicate**:

Running Windows XP with the new drive hooked up, open a command prompt window by selecting `Start Menu: Programs: Accessories: Command Prompt`

Run the Diskpart utility by typing in "`diskpart`".

List the volumes available on the system by typing "`list volume`" at the prompt.

Select the volume to expand by typing in "`select volume #`" at the prompt - where # is the volume number displayed in the volume list.

Expand the volume to include all free space on the disk directly after the selected volume by typing "extend" at the prompt.

Unless DISKPART reported an error, the volume will be extended (type "`list volume`" at the prompt again and it will show the new size of the volume).

This page is http://www.math.columbia.edu/~ bayer/OSX/swapfile/
Please refer to this page for the most up to date version of this information.

Expert instructions

1. Download and read rc.swapfile, take responsibility for the method, and install it as /etc/rc.swapfile

2. Redefine swapvolume in /etc/rc.swapfile, e.g. if df describes your swap partition as

```
/dev/disk0s10  6280512 151776 6128736 2% /Volumes/Swap
```

then edit /etc/rc.swapfile to read

```
swapvolume=Swap
```

3. Edit /etc/rc to read
```
swapdir=/private/var/vm
 if [ -f /etc/rc.swapfile ]; then . /etc/rc.swapfile; fi #
   inserted locally
```

4. If the swap partition is on a non-IDE drive, type in a terminal window
```
sudo defaults write
   /Library/Preferences/SystemConfiguration/autodiskmount
   AutomountDisksWithoutUserLogin -bool true
```

5. Restart

Tutorial Introduction

Moving the swapfile is the crux move, when installing a new release of OS X. There is a lot of partial, conflicting advice on the web concerning how to and whether to relocate the virtual memory swapfile to a separate partition. The speedup is debatable but significant and free; showing the machine who's boss is priceless. OS X is going to use a swapfile whether one moves it or not; a decision to move the swapfile has nothing to do with the question of how much memory to install.

 If one tries to move the swapfile, there are various possible unintended outcomes:
1. The system won't reboot.
2. The system behaves exactly as it did before, not moving the swapfile.
3. The system moves the swapfile as intended, except after forced reboots (Control, Command, and Power keys), and doesn't completely recover on the next normal restart.
4. The system sometimes moves the swapfile as intended, but sometimes wreaks havoc on volume mounting and uses the wrong partition.

This tutorial explains how to figure out if and when a swapfile strategy is working, and how to develop a swapfile strategy that avoids the above pitfalls. It began as my synthesis of what I learned from the web and my experiments, and has become a kind of moderated discussion, as I have learned from other peoples' experiences with different configurations. I welcome further feedback; we all benefit.

 This is a good first hack for Unix novices, but one should read everything written on the web about this topic with a healthy degree of skepticism, including everything written here. Only believe what you can confirm for yourself. Installations and permissions differ; upgraded systems don't behave like clean installs, and because this hack isn't supported by Apple, no one is sure of all the relevant variables. We're all trying to be helpful, but it is easy to make false inferences from a few trials on a few machines. The only sensible approach is to experiment with a clean install of OS X on a machine you can afford to mess up, and determine exactly how your system behaves under a series of experiments.

Familiarize yourself with how your system behaves when it is working properly, so that you can tell the difference when it isn't working properly. Learn to write bits of code by imitation, after reading nearby existing code. Then choose a robust, safe, stress-tested method that you understand for moving the swapfile, move your swapfile, and move on. If it were easier than this, it wouldn't be called a hack.

A good resource for better understanding the Mac OS X boot process is System Startup, found in Mac OS X Documentation. The Bourne shell system-initialization scripts /etc/rc.boot and /etc/rc are run early in the boot process, but after the option to enter single-user mode. We shall be modifying /etc/rc; if imitation doesn't cut it for Bourne shell programming, go to original sources, and read Steve Bourne's Introduction to the Unix Shell.

Partitioning

See Advantages of Multi-Partition Drives for a discussion of the advantages of partitioning. Many believe that ideally, a swap partition should be on a separate and very fast drive. Others, such as laptop users like myself, find it more practical to put the swap partition on the boot drive. The fastest partition on a drive is the first, or outer partition. One should place either the system or swap here, and the other second, but this isn't mandatory. Once a partition fills to 85% of capacity, its performance seriously degrades, so leave room on the system partition for future growth. With developer tools and other third-party additions that must live with the system, my OSX partition contains nearly 6 GB of files. For a while I arranged my TiBook partitions Swap (3 GB), OSX (9 GB), OS9 (2 GB), User (41.4 GB), and I put users and any third-party applications that I can on User. This proved too tight for the OSX partition (Adobe products sometimes filled it with their cache files) so when I moved to an 80 GB internal drive after a drive failure, I increased OSX to 15 GB for good measure. If I'd had an on-the-fly repartitioning tool like VolumeWorks, I would have done this sooner.

A longstanding rule of thumb is to make the swap partition twice the size of physical memory. I remember the gas lights era when this meant 32 MB for a 16 MB Unix machine, and we watched math computations use this 32 MB that would have needed 1 GB if we hadn't compressed the program's internal data. Then as now, when a single process begins to page-thrash, it is very painful to watch. We walked away; no one has the patience to just sit there. The signature is different when several processes collectively need more than physical memory, but they each fit by themselves: Switching between processes is slower, but one can stand to be in front of the machine. The signature is different again for a memory leak. By definition the leaked memory is never used again, so the process merrily marks as used far more than physical memory with no noticeable performance hit, until swap runs out and the process goes splat.

The swap partition also makes a handy bootstrap partition. One can backup, repartition, install a minimum system on Swap, boot from this system to restore the other partitions, and then erase Swap and use it as a swap partition. This argues for a size of at least 1.5 GB, to fit a minimum system and restore software.

Alternatively, the Apple application Activity Monitor indicates for my system memory a VM size of variable size, often around 4-5 GB. A smaller swap partition than this will become the limiting factor for virtual memory. Use a swap partition which is larger than this size, if you can afford the disk space. A bit larger gives the file system room to turn around, but much larger is wasted.

The bottom line: If you need more than twice physical memory for your swap partition, you know who you are. People who say they need more swap than this probably have undiagnosed memory leaks, which are indeed being reported for 10.3.

To move a user, e.g. me, to a User partition, type into into the Terminal application
```
sudo ditto -v -rsrcFork /Users/me /Volumes/User/Users/me
```

Now open the NetInfo Manager application and edit the user me to reflect this change:
```
home /Volumes/User/Users/me
```

Now remove the original directory in Terminal:
```
cd /Users
sudo rm -rf me
```

You may need to temporarily give another user administrative priviledges to finish moving the administrative user; I've had luck both ways. Leave /Users/Shared alone, Adobe Acrobat 6 for example won't install without it.

Virtual Memory

How does virtual memory work, out of the box? The system-initialization script /etc/rc contains the swapfile code
```
swapdir=/private/var/vm
if [ "${netboot}" = "1" ]; then
    sh /etc/rc.netboot setup_vm ${swapdir}
fi

# Make sure the swapfile exists
if [ ! -d ${swapdir} ]; then
    echo "Creating default swap directory"
    mount -uw /
    mkdir -p -m 755 ${swapdir}
    chown root:wheel ${swapdir}
else
    rm -rf ${swapdir}/swap*
fi

dynamic_pager -F ${swapdir}/swapfile
```

In principle, to move the swapfile, one simply redefines swapdir at the start of this code. The problem is that the partition Swap typically hasn't mounted yet.

To understand business as usual, type man df or man ls into the Terminal application, to understand the Unix commands we're about to use. The space bar moves forward through this documentation, and the Q key quits. Now type the display free disk space command
```
df
```

Getting a listing of the form

```
Filesystem              512-blocks      Used     Avail Capacity  Mounted on
/dev/disk0s12             18862272  12274896   6398760     66%   /
devfs                          202       202         0    100%   /dev
fdesc                            2         2         0    100%   /dev
<volfs>                       1024      1024         0    100%   /.vol
/dev/disk0s10              6280512    151776   6128736      2%   /Volumes/Swap
/dev/disk0s14              4183488   1126792   3056696     27%   /Volumes/OS9
/dev/disk0s16             86823312  50578912 36244400     58%   /Volumes/User
automount -nsl [380]             0         0         0    100%   /Network
automount -fstab [394]           0         0         0    100%
/automount/Servers
automount -static [394]          0         0         0    100%
/automount/static
```

Note that the system's internal BSD name for my swap partition is /dev/disk0s10 and its Finder name is Swap; in all that follows, use instead of /dev/disk0s10 the internal BSD name of your swap partition and instead of Swap the Finder name of your swap partition.

Now type the list directory contents command
```
ls -l /Volumes
```

Getting a directory listing of the form

```
drwxrwxrwx  18 root   staff      612  5 Jan 14:29 OS9
lrwxr-xr-x   1 root   admin        1  5 Jan 15:34 OSX -> /
drwxr-xr-x   7 admin  staff      238  5 Jan 15:34 Swap
drwxrwxrwx  18 root   staff      612  5 Jan 14:20 User
```

This is where the system mounts volumes; they look like directories, and indeed the system can also put directories here, intentionally or as a result of swapfile code gone haywire. Now type
```
ls -l /private/var/vm
```

Getting a directory listing of the form

```
drwx--x--x  8 root   wheel        272  5 Jan 15:30 app_profile
-rw------T  1 root   wheel   67108864  5 Jan 15:34 swapfile0
```

Note that the file swapfile0 was created at the time of the most recent boot, while the directory app_profile is older. app_profile maintains information about applications across boots, and probably shouldn't be moved unless your swapfile hack works all of the time; I choose never to move app_profile. However, swapfile0 is set up from scratch on every boot, and there is no harm in having different boots choose different locations, as long as obsolete files are deleted. Recognizing this is key to working out a graceful strategy for dealing with exceptional boots.

Editing

To edit /etc/rc, type into Terminal
```
cd /etc
sudo cp rc rc.original
sudo pico rc
```

This changes directories to /etc, and as superuser makes a backup copy of rc and edits rc using the pico command line editor. pico is a better choice than vi or emacs for casual users, because its directions are printed on the bottom; ^ stands for the Control key. vi is more powerful but has a steeper learning curve. emacs was abbreviated from *"eight megabytes and constantly swapping"* in an era when that was real money; a cat walking across an emacs keyboard could rearrange the orbits of the planets.

Alternatively, type into Terminal
```
sudo /Applications/TextEdit.app/Contents/MacOS/TextEdit
/etc/rc &
```

To edit as superuser with TextEdit, or install the demo or pay version of BBEdit and choose Open Hidden... from its File menu, showing All Files.

It is a good idea, however, to be able to use a command line editor in a pinch. If the /etc/rc file gets sufficiently messed up, the system may refuse to boot except in single-user mode. One chooses to boot in single-user mode by pressing the Command and S keys as the computer starts up; I have also been thrown into single-user mode after adding a single misplaced space character to /etc/rc. The computer screen is black with white text, and accepts any Unix command. If the root device is mounted read-only, follow the directions given on-screen before proceeding. One can run the pico command line editor, remove troublesome insertions from the /etc/rc or /etc/fstab files, and reboot normally.

Experimenting

How can one tell if Swap has mounted yet? Edit /etc/rc *once*, inserting the line
swapdir=/private/var/vm

```
 if [ -f /etc/rc.swapfile ]; then . /etc/rc.swapfile; fi #
inserted locally

if [ "${netboot}" = "1" ]; then
    sh /etc/rc.netboot setup_vm ${swapdir}
fi
```

This insertion is harmless by itself, because the file rc.swapfile doesn't exist yet. When the file rc.swapfile exists, this line executes the contents of rc.swapfile exactly as if it were inserted here. Any typos in rc.swapfile will still derail the startup process, throwing us into single-user mode, but we will be able to recover simply by renaming rc.swapfile:

```
cd /etc
mv rc.swapfile rc.swapfile.off
reboot
```

Astronauts, pilots, and scuba divers practice emergency maneuvers until they become routine; you may want to try single-user mode now. Create a file /etc/rc.swapfile with contents

```
swapvolume = Swap
ConsoleMessage "swapvolume defined as ${swapvolume}"
```

and restart. There aren't supposed to be spaces around the equals sign, so this will throw you into single-user mode. Recover.

To see console messages while booting, boot in verbose mode with the Command and V keys. The screen will look like single-user mode while these messages print.

Now, we can imitate the existing code that determines if the swapfile exists. Create a file /etc/rc.swapfile with contents

```
swapvolume=Swap

if [ -d /Volumes/${swapvolume} ]; then
    ConsoleMessage "${swapvolume} available"
else
    ConsoleMessage "${swapvolume} not available"
fi
```

and restart. This code prints a message to the system log file /var/log/system.log, telling us whether or not /Volumes/Swap is present in the file system at the time of the message. This code does not distinguish between a mounted volume and a directory, an issue that will become significant later, but doesn't matter now.

To read these messages after a system restart, type into Terminal

```
grep Swap /var/log/system.log | tail
```

to see the last 10 lines of /var/log/system.log containing the word Swap. Confirm that Swap doesn't mount in time for the swapfile code of /etc/rc, by looking for lines of the form

```
Dec 23 16:37:59 localhost ConsoleMessage: Swap not
available
```

Read from the bottom up, paying attention to times and recalling your last boot time.

A more cautious approach would have been to test rc.swapfile before restarting. To do so, add to rc.swapfile the lines

```
#!/bin/sh

swapvolume=Swap

if [ -d /Volumes/${swapvolume} ]; then
    ConsoleMessage "${swapvolume} available"
else
    ConsoleMessage "${swapvolume} not available"
fi

 echo "rc.swapfile is finished"
```

In a terminal, change directories to the directory of your test version of
rc.swapfile, by typing cd and a space, dragging rc.swapfile from the Finder into
the terminal window to paste its path, backspacing over "/rc.swapfile", and
pressing return. Now type
```
chmod +x rc.swapfile
./rc.swapfile
```

 and study the error messages. The ConsoleMessage command is unavailable,
and will generate a message; we want to see the "rc.swapfile is finished"
message. Any other messages are a cause for concern. This only tests part of
our conditional logic; change the if to
```
if [ ! -d /Volumes/${swapvolume} ]; then
```

 to toggle the logic and test again; remember to change it back. After testing,
there is no harm in leaving this extra code in place.

 The simplest way to get Swap to mount in time after normal restarts is to add a
line to the system file /etc/fstab:
```
# fs_spec                                fs_file
fs_vfstype   fs_mntops
#
# UUID=DF000C7E-AE0C-3B15-B730-DFD2EF15CB91  /export  ufs
ro
# UUID=FAB060E9-79F7-33FF-BE85-E1D3ABD3EDEA  none     hfs
rw,noauto
# LABEL=This\040Is\040The\040Volume\040Name  none     msdos
ro
 /dev/disk0s10 /Volumes/Swap hfs rw 1 2
```

Be sure to replace the BSD name /dev/disk0s10 with the BSD name that
corresponds to your swap partition.

There is a flaw, however, with this modification to /etc/fstab: BSD names are
created at boot time, and are not guaranteed to be consistent across boots. In
practice, it appears that the partitions on the boot device get numbered
consistently, but other devices get numbered in the order that they spin up.
However, even this is not documented as certain. See the discussion Topic: drive
numbering inconsistent /dev/diskXs10 ?.

There are other, more stable ways of referencing Swap:
```
UUID=AC05CEB8-906A-3AB1-BD04-D0FC29B9C384 /Volumes/Swap hfs
rw 1 2
LABEL=Swap /Volumes/Swap hfs rw 1 2
```

Unfortunately, these are only understood by autodiskmount, and do not appear to help us here. I could sometimes get these forms to work, but never to any advantage for our purposes.

My preferred approach is patience: If Swap hasn't mounted in time, wait a few seconds. Do not modify /etc/fstab. Instead, try a more elaborate version of /etc/rc.swapfile:
```
swapvolume=Swap

if [ ! -d /Volumes/${swapvolume} ]; then
    swapcount=1
    ConsoleMessage "Waiting for ${swapvolume} to mount"
    while [ "$swapcount" -le 30 ]; do
        sleep 1
        if [ -d /Volumes/${swapvolume} ]; then
            ConsoleMessage "${swapvolume} mounted after
$swapcount seconds"
            break
        fi
        swapcount=`expr $swapcount + 1`
    done
fi

if [ -d /Volumes/${swapvolume} ]; then
    ConsoleMessage "${swapvolume} available"
else
    ConsoleMessage "${swapvolume} not available"
fi
```

Observe now that if Swap is a partition on the boot drive or on an IDE drive, then it mounts within a few seconds. Otherwise, Swap fails to mount. It turns out that in OS X 10.3, these drives don't mount until a user logs in. See 10.3: A fix for local drives not mounting until user login The fix is to type into a terminal

```
sudo defaults write
/Library/Preferences/SystemConfiguration/autodiskmount
AutomountDisksWithoutUserLogin -bool true
```

Now confirm that Swap mounts in time for the swapfile code of /etc/rc. Stress-test this mechanism: Log out all users, wait for the system to quiet down, and perform a forced reboot by pressing the Control, Command, and Power keys. Note that Swap still mounts in time after forced reboots.

A forced reboot is an emergency procedure; OS X is a swarming anthill of background processes, all of which get killed without ceremony by a forced reboot. The system can end up in an unstable state, turning your hacking session into a recovery session. It is essential to log out all users before testing forced reboots; in particular, anyone logged in and using FileVault could get hosed. There seems to be no completely safe protocol for testing forced reboots; the same key combination while asleep simply wakes the computer, and a forced reboot in single-user mode appears to skip the extra checks. Apparently, if we know the boot is safe, the system also knows the boot is safe.

 It is important to have sorted out how to mount the swap partition *before* trying to move the swapfile, because moving the swapfile during these experiments can make a mess that is difficult to clean up. If you tell the system to use /Volumes/Swap before it mounts, it creates and uses a directory by the same name, and later, Swap mounts as /Volumes/Swap 1. This is a truly famous mishap for swapfile adventurers. From now on, the *directory* Swap passes the test to see if Swap has mounted. One way to dig out of this hole is to rename the Swap partition, comment out every reference to Swap, and reboot, so that Swap becomes an unused directory that can be deleted. However, if this fix goes poorly, you only compound the problem. It is better never to make this mistake in the first place.

For this reason, a safer test is
```
if [ -d /Volumes/Swap/.Trashes ]; then
```

 because the invisible .Trashes directory exists on volumes, but not typically in other directories.

Warning: Various people have dramatically sped up their boot times by patching the behavior of BootCacheControl, as described in Topic: HOWTO: Slow 10.3.2 startup fix. I now recommend against this modification. I traced a problem to this fix, where my restarts were hanging indefinitely at the "Login Window Starting" prompt. I'm guessing my boot cache got out of sync. This makes sense; a cache out of sync can wreak all manner of havoc. Apple couldn't get it working, took it out, others discovered they could put it back in, it usually works... Know the song? To remove this fix, type
```
sudo rm /usr/sbin/BootCacheControl
```

Moving the swapfile

We are now ready to try a patient, conservative strategy: Leave app_profile alone. Move the swapfile if we can, but check first to see if we can, and do something reasonable no matter what happens.

Replace the contents of /etc/rc.swapfile with the code

```
##
# After the line in the system startup script /etc/rc
#
#    swapdir=/private/var/vm
#
# insert the line
#
#   if [ -f /etc/rc.swapfile ]; then . /etc/rc.swapfile; fi
# inserted locally
##

swapvolume=Swap

if [ ! -d /Volumes/${swapvolume}/.Trashes ]; then
    swapcount=1
    ConsoleMessage "Waiting for ${swapvolume} to mount"
    while [ "$swapcount" -le 30 ]; do
        sleep 1
        if [ -d /Volumes/${swapvolume}/.Trashes ]; then
            ConsoleMessage "${swapvolume} mounted after
$swapcount seconds"
            break
        fi
        swapcount=`expr $swapcount + 1`
    done
fi

if [ -d /Volumes/${swapvolume}/.Trashes ]; then
    ConsoleMessage "Using ${swapvolume} for swapfile"
    if [ -f ${swapdir}/swapfile0 ]; then
        rm -rf ${swapdir}/swap*
    fi
    swapdir=/Volumes/${swapvolume}/.vm
else
    ConsoleMessage "Unable to use ${swapvolume} for
swapfile"
fi
```

Test this code under a variety of conditions. This code has been groomed by various people, and has the following virtues:

- It leaves the existing code in /etc/rc alone, inserting new code that redefines swapdir only if it can. To revert, or to temporarily turn off moving the swapfile, rename /etc/rc.swapfile to /etc/rc.swapfile.off.
- It fails gracefully if Swap fails to mount, using instead the original swapfile location.
- When it succeeds after a failure, it again works as intended, and deletes the obsolete swap files from the original swapfile location.
- The name of the original swapfile location is not hard-wired into the insertion, so this code is more likely to work without editing in future versions of /etc/rc.
- If a system update overwrites /etc/rc, we simply hook up /etc/rc.swapfile again, following its commented directions.

If you can pick any more fleas off this code, however obscure, let me know. It is intentionally intolerant of spaces in the name of the swap partition, because the code in /etc/rc is similarly intolerant. One could instead define a symbolic link, to permit spaces without further modifying /etc/rc, but it is simpler to not use spaces. Simple is good.

If your swap partition is on your boot drive, you can probably get away with shaving a few seconds off each normal restart by also modifying /etc/fstab, using a BSD name like /dev/disk0s10. To me, this slight speedup doesn't seem worth the potential risk.

Alternatives

Further testing establishes that Swap is nearly always mounted by the end of /etc/rc, after the SystemStarter call:

```
SystemStarter -gr ${VerboseFlag} ${SafeBoot}

exit 0
```

This is also true after forced reboots. Others have had success with simply redefining swapdir, and moving the existing swapfile code in /etc/rc to just before the exit line. However, SystemStarter calls a plethora of startup scripts, all of which would then run without benefit of virtual memory. I cannot see any harm in this, but as a mathematician I've learned that a lack of imagination is not a proof of anything.

An alternative proposed by ptwithy on Mac OS X Hints, is extremely amusing:

```
Insert instead into /etc/fstab
/dev/disk0s10 /private/var/vm hfs rw 1 2
```

This has the distinct advantage of avoiding any need to edit /etc/rc; it mounts Swap where /etc/rc already wants to put the swapfile. There are compelling arguments for *not* modifying "Apple-owned" system files such as /etc/rc; one is that Apple may overwrite your mods without warning on any future system update. The disadvantage to this method is that it doesn't address the issues raised by forced reboots. It can waste space on the root volume: After a forced reboot, Swap is instead mounted as /Volumes/Swap, and the swapfile is placed in the *directory* /private/var/vm. After the next normal restart, all is well again, but the *directory* /private/var/vm is inaccessible, having been replaced in the directory tree by the *volume* /private/var/vm, and its obsolete swap files hang around unerased, choking the root volume. Also, this strategy effectively maintains two versions of app_profile, one for forced boots. It also runs into the BSD name issue; I could not get the alternative /etc/fstab forms to work here.

Automated Solutions

There are various automated solutions out there for moving the swapfile. I prefer to carefully understand all modifications to my system, so that I can debug problems. However, the vast majority of people who move their swapfile are going to rely on an automated solution they don't understand. If you've understood this far, you share a responsibility to the community to go pick a current automated solution and dissect it, and give the author feedback. In my experience, the authors of these programs are extremely responsive. In addition, if you see a "*just use this program, it worked fine for me*" post on the web, where the author of the post gives no clue that they examined the changes to their system, consider posting a followup with your analysis. Without such followups, all anyone can safely assume is that the test system didn't curl blue smoke.

One example of an automated solution that provides beta support for OS X 10.3 behaves as follows, as of January 9, 2004: It presents a slick, confidence-inspiring user interface. (One shouldn't draw conclusions from this; the Cocoa framework makes this easier than any non-programmer would believe possible.) After the user selects the swap volume, it makes a backup copy of /etc/rc, and make the following changes to /etc/rc:

It replaces the line
```
swapdir=/private/var/vm
```

with the lines
```
/sbin/autodiskmount
sleep 3
swapdir=/Volumes/Swap/vm
```

and it replaces the line
```
appprofiledir=/private/var/vm/app_profile
```

 with the line
```
appprofiledir=/Volumes/Swap/vm/app_profile
```

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MOVING THE SWAP FILE IN OS X

In testing, this worked for me, once after a normal restart and once after a forced reboot. However, no option is provided to change the autodiskmount defaults for non-IDE drives, so they could pose a problem. In my experience, the call to autodiskmount is harmless, but has no appreciable effect on waiting times; the volumes that are going to mount are already about to mount. Waiting 3 seconds usually suffices, but I've experienced delays of up to 11 seconds, hence my preference for a conditional loop. There is also no conditional code to notice if Swap fails to mount, so this method could make one of the classic mounting messes in /Volume, with no provision for cleaning it up.

Acknowledgements

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